fore they appear in the afternoon papers. At the corners of the stand, on the street side, are a thermometer and a barometer. The clock stands are made of cast iron, bolted securely to the sidewalk paving. Arrangements are made, when necessary, to illuminate by electricity the clock faces and the advertising panels. The whole arrangement reminds us of the so-called Urania Columns established by the Urania Gesellschaft in Berlin, and they will doubtless be as popular in America as they have become in Germany.

ELECTRIC WAVES IN THE ATMOSPHERE.

In the MONTHLY WEATHER REVIEW for November, 1896, XXIV, p. 409, there are some remarks by Prof. John Trowbridge on the possibility of detecting the transmission of electric waves from the sun to the earth. All wave phenomena have certain points of analogy. Our eyes and ears are simply machines for catching optical and acoustical waves; as a tide mill can be arranged to abstract power from the ocean waves, so, also, the electric current may be treated if it behaves like a wave-like phenomenon. The flow of a current of water thrown into waves by an obstacle is analogous to the flow of electricity. The following remarks are taken from a report by Charles de Kay, United States consul-general at Berlin, in the consular reports for September, 1897:

The electrical waves are not believed to be vibrations in the air itself, but rather in the ether between the particles of air; as compared to light waves, they are of enormous size.

That the electric waves do in many ways act like light rays, though they are much longer, I saw recently demonstrated in a lecture I was permitted to attend at the Polytechnic School in Charlottenburg, Berlin. To get some idea of the relative size of electric waves when compared with those of light, imagine that the light waves are represented by the width of the Hudson River at New York City; then the electric waves would be represented by the Atlantic Ocean and Baltic Sea, say from New York to St. Petersburg, or, to express it acoustically, the waves of light are so high and sharp, while those of electricity are so long and deep, that the light waves may be compared to the highest, shrillest sound which the human ear can grasp, while those of electricity are comparable to the deepest diapason note of an organ.

The lecture alluded to was one which Professor Rubens, a young German of Dutch descent, now employed as instructor at the Polytechnic, recently gave to a number of teachers. Since Herz's death, in 1888, he said, much progress has been made in reducing the size of the electric-wave generator. As the size of the apparatus has a relation to the length of the electric waves, and as it was desirable to shorten these waves, the decreased size of the apparatus has been of use in making air telegraphy more practicable. Shorter electric waves are more approximate in their action to waves of light and go farther. Up to the present the shortest are those of the Russian experimenter, Lebedeff, who has produced them from 6 to 7 millimeters long. Professor Rubens showed a thermo element, or heat catcher, invented by himself to take the place of Marconi's coherer, which, like the coherer, catches the refracted and focused electric rays. The spark, he observed, was not at all a necessary phenomenon in electricity. He then made many curious experiments to show the similarity in action of waves of light and waves of electricity, and also drew attention to the very different way in which electric and light waves pass through different substances; thus, he reflected electric waves like light, refracted them with prisms, and diffracted them with a wire grating of parallel wires, as light is diffracted by Rowland's gratings. He then showed the polarization of these rays, freely through the fibers of wood longitudinally and badly across the fiber, easily through closed books with the leaves and with difficulty across the leaves. Thus, a pile of books or sheets of glass showed polarization like crystals under light. He showed, also, that, on account of the length of these waves, their energy was absorbed differently by different substances; thus (1), water absorbs all the energy, (2) metals absorb all the energy, (3) glass absorbs nearly all, (4) paraffin absorbs hardly any, and (5) hard rubber absorbs hardly any. Thus, they move through hard black rubber and paraffin as light moves through air, glass or water—that is to say, with hardly any resistance—while glass lets very little of them through, and metal and water are impervious to them.

Professor Rubens imbeds his Herz generator in petroleum [paraffin?] for better isolation; and as a handy concentrator of the electric waves uses a round glass bottle filled with petroleum. By placing in turn the glass prism, wire grating, block of wood, pile of books, water, paraffin, and hard rubber in the line of the unseen electric waves pouring from the generator and concentrator toward the wave catcher, he showed on an indicator the easy or retarded passage or the entire interruption of the unseen flow of electric waves.

ELECTRICAL DISTRICTS.

Under date of August 29 Dr. Albert A. Banks sends a diagram showing that within 120 feet of a small house near Columbus, Ga., lightning has struck either house or trees six times during the past fifteen years, the distances being, respectively, 9, 10, 10, 14, 25, and 40 yards, and he asks whether such frequency within such a small area is not unusual, and if there is any significance in this play of the lightning.

We regret that we have not any statistics at hand that will show clearly the average number of strokes per square mile for fifteen years in that part of Georgia, and, therefore, whether this is an unusual case. The testimony of Dr. Banks' neighbors would be more valuable than any theory or opinion of ours. If neighboring houses have not had a similar experience, then there must be some significance in this one; but what that may be, whether it is in the topography or in the underground water, or in the concentration of the paths of thunderstorms, we would not pretend to suggest. We publish this query in the MONTHLY WEATHER REVIEW in hope that some observer near Columbus, Ga., may furnish other cases of similar lightning frequency, so that we may have data enough to elucidate the question.

LIGHTNING AND MAGNETIC ROCKS.

Prof. F. Pockels, of Dresden, communicates to the new annual (Jahrbuch für mineralogie) an argument in favor of the idea that the magnetism observed in almost every stratum of rock, and most of all in the so-called magnetic iron ore, has been produced therein locally by the lightning, or in mountain regions by the perpetual discharge of atmospheric electricity. He says that the magnetic rocks occur in exposed places that protrude prominently above the flat country, and that the north and south poles in these rock masses occur in a perfectly irregular interchangeability, often within very short distances, such as a few centimeters, so that their magnetism can not be due to the inductive action of the earth's magnetic field, as was supposed by Melloni. The latter may have an influence, but it is too feeble for ordinary observation.

In connection with Toepler, Pockels has made a number of experiments on the effect of electrical discharges upon various kinds of stone. Some of these show no magnetism, others become magnetic and rapidly lose that condition, while still others become strongly and permanently magnetic, so that in general he concludes that all forms of stone which show permanent magnetism in natural exposed localities also become magnetic when subjected to the artificial electric spark, so that it is almost certain that the discharges of atmospheric electricity are the cause of the natural magnetism of magnetic stones.

Pockels' conclusion seems to be confirmed by the fact that Professor Barus found no magnetic ore in the deep mines, and no earth currents when he explored them. The almost continuous earth currents in northern countries, such as attend auroras, may have as strong an influence as the lightning of the tropics.

THE STRUCTURE OF HAILSTONES.

In Bauer's new Annual for Mineralogy, published at Stuttgart, Vol. I, page 259, Prof. F. Rinne gives an interesting description of some peculiar hailstones that fell at Hannover on the 9th of January, 1897, as follows:

After many days of cold, extending down to 10° C. without precipitation, there fell at Hannover on January 9, with rising temperature, an abundance of snow, which occasionally disclosed its compact structure by the characteristic rattling noise of falling hail, and especially by blows of the particles of ice on the window panes of the room. The falling of such snow-ice could also be observed after the precipitation

had been partly converted into water in consequence of the rising temperature. The rain water that fell with the particles of ice soon froze to smooth sheets of ice.

The hail in question gradually accumulated to a thick layer. It consisted of an extraordinary large number of small spheres, generally only a few millimeters in diameter, which, by their clear transparency, presented a very beautiful appearance. The little spheres lay at first close to each other on the ground and were rolled about by the wind. Afterwards, by partial thawing and freezing or by freezing the water between them, they adhered to each other and thus produced the impression of transparent fish roe.

The perfect clearness of the dainty drops of ice made it improbable that they would have a radial structure like the sphereolites. Under the microscope many of these, as seen by polarized light, were demonstrably composite, but a great number, on the other hand, and especially the smaller ones, seemed to be simply and uniformly constructed out of one single crystal of ice. We have, therefore, here a remarkable case of individual spherical crystals which, in opposition to the ordinary angular form of the crystal, possess an outer surface of uniform curvature, so that a description in crystalographic nomenclature could only be obtained after a physical determination of the axes. These little spheres under polarized light, viz, between crossed nicol prisms, showed very beautiful polarization phenomena; as they were not hollow, they showed in the center the higher colors, for instance, the green of the second order and diminishing outward in ring-like zones they showed the lower colors in gradual transition. The changing of these polarization colors as the ice spheres melted was especially beautiful.

The extinction of the light as the analyzing prism was turned was smooth and clean, so that, considering the positive double refraction of the ice, the meridian plane of the sphere could easily be determined. Those spheres that lay in appropriate positions upon the stage of the microscope showed in converging polarized light the phenomena characteristic of optical uniaxial crystals, and by testing with a thin plate of gypsum, corresponding with the red of the first order, showed positive double refraction.

Some of the ice particles were bounded by a circular plane surface and a portion of a spherical surface. They were, therefore, certainly only pieces of hailstones, but as it was precisely these that showed the black cross with bright rings when examined with converging polarized light as they lay upon their flat faces, it would seem as though the respective spheres in consequence of their cleavability had been cloven along one of their principal planes by striking other hard bodies; at least this explanation seems to me more probable than that of an original hemimorphic structure in the crystals.

The complex ice spheres showed in polarized light a honeycomb appearance, whence it may be inferred that they were made up of a number of nucleii; the arrangement of the nucleii was irregular. Occasionally in such a little sphere of ice there would be remarked a needle of ice whose location in reference to the sphere seemed not to be arranged according to any law. The needles or bars of ice themselves showed that they were built up of nucleii irregularly arranged. Microscopic round and irregular-shaped bubbles of air collected in groups on the surfaces were quite frequently found, notwithstanding the extreme clearness of the ice formation.

As to the question of the origin of the spherical crystals of ice and the crystalline bars it can not be doubted that we have to do with frozen drops of rain.

I have attempted to make such frozen spheres artificially. If we allow a drop of distilled water that is hanging at the end of a delicate thread, and that forms a nearly spherical ball, to freeze, we obtain a clear sphere of ice. These artificial formations all prove to be complex in their structure.

In their mode of occurrence the above-mentioned spheres of ice remind one in some respects of the chondrule of meteoric stones. (The chondrules are small spherical grains of foreign minerals often with an imperfect radial structure imbedded in meteoric stones.) The history of the origin of these forms is probably also analogous to that of the spheres of ice, in so far as they are frozen drops. The sphere of ice as a unit corresponds especially to the monosomatic chondrule of Tschermak, in which the whole of the little sphere is built up of one round crystal as a unit.

The rest of Professor Rinne's article relates to the structure of meteors rather than to that of hailstones. If we may pass from his study of this particular case of sleet and hail to the larger hailstones that accompany American thunderstorms, one might infer the probability that the latter, upon examination with polarized light, would also be found to have a composite structure. But such matters should not be left to analogy or hypothesis. It is very much to be desired that the numerous physicists of our colleges and schools of science should apply their elaborate outfits of optical apparatus to the minute investigation of the destructive but magnificent hailstones that so frequently occur in connection with our violent thunderstorms.

THE ANCIENT CLIMATE OF ARIZONA.

In May last, Mr. W. T. Blythe, Weather Bureau observer at Phœnix, Ariz., sent to the Central Office some specimens of seeds, cloth, and cord taken from a mummy found among the cliff dwellings of Arizona. In hopes that the nature of the plants to which these three objects belonged might be identified, and that something might result by way of information relative to the climate at the time these plants were living, the specimens were referred to the botanist of the Department of Agriculture. It was ascertained by microscopic examination that "the cloth was made of cotton, but the cord accompanying it was made of a fibre that is not at present recognizable. The seeds appeared to be those of an Aramantus, several species of which are still in use for food by various peoples, including the Indians of the southwestern portion of the United States." An effort was made to raise some plants from these seeds, but they failed to germinate. The general outcome of this study is simply to show that there is no evidence of any material change in the climate of Arizona since the days of the cliff dwellers.

VITALITY OF SEEDS.

Many stories are current in the newspapers of success in sprouting and raising plants from seeds found in Egyptian and Peruvian mummies or burial places, and even still more extravagant tales of plants raised from seeds buried many feet deep in the earth in strata that must have been laid to rest not only in the days of the glacial epoch but in still earlier geological ages, but not a single one of these stories has stood the test of careful investigation; either they were pure fabrications or the plants that actually grew belonged to modern flora and sprang from really fresh seeds; it is proper to say that the cautious botanist puts no faith whatever in these stories, partly because the proper tests have not been applied, but principally because of the results of so many experiments that have been made with great care to test the vitality of ordinary seeds. Every farmer knows that the proportion of seeds that will sprout diminishes year by year the longer the seeds are kept, so that at the end of ten years not one per cent of the ordinary seeds retain their vitality. There are indeed certain plants which in their wild or natural state have a vastly greater vitality than others, but the seeds of food plants cultivated by mankind are among the most delicate. The molecular structure of seeds, and not only seeds, but almost every other substance, whether animal, vegetable, or mineral, undergoes a slow change with time. Wherever sunshine, air, and water can penetrate, there molecular changes are persistently going on; these changes are usually of the nature of a slow oxidation; in the case of animal and vegetable material buried under the soil, far away from sunshine and air, there is a rearrangement of the molecules of carbon, oxygen, and hydrogen, so that they become converted into coal oil and coal oil gas. It is contrary to nature that seeds should retain their vitality under these circumstances; nevertheless the attempt to make them germinate should be made because it does seem as though there might, by chance, be found one that had escaped decomposition. It is equally important to first subject ancient seeds and fabrics, wherever found, to a microscopic examination, since some minute detail of structure may reveal the nature of the plants from which they came.

In general, those Weather Bureau observers and correspondents who happen to be in a position to collect interesting mementoes of the early races that have inhabited this continent would do well to refer their finds directly to the National